

WHAT IS CLAIMED IS:

1. An interprocessor communication method of exchanging the contents of register files among processors constituting a multiprocessor system, comprising the steps of:

dividing a group of processors constituting the multiprocessor system into a plurality of groups of processing elements,

conducting interprocessor communication by physically sharing the same register file among processors belonging to the same processing element, and

conducting interprocessor communication by directly transferring the contents of a register file through a bus between processors belonging to different processing elements.

2. The interprocessor communication method as set forth in claim 1, wherein

a bus is used which has a channel one-to-one corresponding to each register included in the register file.

3. The interprocessor communication method as set forth in claim 1, wherein

a bus having a channel whose number is smaller than the number of registers included in the register

5 file is used to enable a plurality of registers to share  
one channel.

4. The interprocessor communication method as set  
forth in claim 1, wherein

a bus structure formed of a plurality of buses  
and a bridge for relaying data between the buses is used,  
5 in which a group of processing elements is divided into  
a plurality of groups, communication between processing  
elements belonging to the same group is conducted  
through the same one bus and communication between  
processing elements belonging to different groups is  
10 conducted through a plurality of buses using the bridge.

5. The interprocessor communication method as set  
forth in claim 1, wherein

a bus structure formed of a plurality of local  
buses, not less than one global bus and a bridge for  
relaying data between the buses is used, in which a  
5 group of processing elements is divided into a plurality  
of groups, communication between processing elements  
belonging to the same group is conducted through the  
same one local bus and communication between processing  
10 elements belonging to different groups is conducted  
through a plurality of buses using the bridge.

6. The interprocessor communication method as set

forth in claim 1, wherein

5 a bus structure formed of a plurality of buses  
and a bridge for relaying data between the buses is used,  
in which a group of processing elements is divided into  
a plurality of groups, communication between processing  
elements belonging to the same group is conducted  
through the same one bus and communication between  
processing elements belonging to different groups is  
10 conducted through a plurality of buses using the bridge,  
and

not less than one route which connects the  
processing elements by a bus and causes no bus  
contention with other routes is determined in advance to  
15 conduct only interprocessor communication using the  
determined route.

7. The interprocessor communication method as set  
forth in claim 1, wherein

5 a bus structure formed of a plurality of local  
buses, not less than one global bus and a bridge for  
relaying data between the buses is used, in which a  
group of processing elements is divided into a plurality  
of groups, communication between processing elements  
belonging to the same group is conducted through the  
same one local bus and communication between processing  
10 elements belonging to different groups is conducted  
through a plurality of buses using the bridge, and

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not less than one route which connects the  
processing elements by a bus and causes no bus  
contention with other routes is determined in advance to  
conduct only interprocessor communication using the  
determined route.

8. The interprocessor communication method as set  
forth in claim 1, wherein

a bus structure formed of a plurality of buses  
and a bridge for relaying data between the buses is used,  
in which a group of processing elements is divided into  
a plurality of groups, communication between processing  
elements belonging to the same group is conducted  
through the same one bus and communication between  
processing elements belonging to different groups is  
conducted through a plurality of buses using the bridge,  
and

not less than one route which connects the  
processing elements by a bus and causes no time  
contention on the same bus with other routes and a time  
of use of each bus by each route are determined in  
advance to time-divisionally use the buses, thereby  
conducting only interprocessor communication using said  
determined route and time of use.

9. The interprocessor communication method as set  
forth in claim 1, wherein

5 a bus structure formed of a plurality of local  
buses, not less than one global bus and a bridge for  
relaying data between the buses is used, in which a  
group of processing elements is divided into a plurality  
of groups, communication between processing elements  
belonging to the same group is conducted through the  
same one local bus and communication between processing  
10 elements belonging to different groups is conducted  
through a plurality of buses using the bridge, and

not less than one route which connects the  
processing elements by a bus and causes no time  
contention on the same bus with other routes and a time  
15 of use of each bus by each route are determined in  
advance to time-divisionally use the buses, thereby  
conducting only interprocessor communication using said  
determined route and time of use.

10. The interprocessor communication method as set  
forth in claim 8, wherein

the processors are operated in synchronization  
with time and each processor is programmed to execute  
5 only the interprocessor communication by said determined  
route and time of use, and each bridge conducts data  
relay operation only in the interprocessor communication  
by said determined route and time of use, thereby time-  
divisionally using the buses.

11. The interprocessor communication method as set forth in claim 8, wherein

a transmission control unit for controlling transmission of the contents of the register file in the processing element through the bus according to a transmission request from the processor belonging to the processing element in question provides control such that only interprocessor communication by said determined route and time of use is conducted and each bridge executes data relay operation only in interprocessor communication by said determined route and time of use, thereby time-divisionally using the buses.

12. The interprocessor communication method as set forth in claim 8, wherein

a time table for conducting input/output control by time is provided in the processing element and a time table for conducting relay control by time is provided in the bridge, and input/output control at the processing element and path control at the bridge are determined uniquely with respect to time by using these time tables, and

when a transmission request is made from the processor, a transmission control unit in the processing element refers to the time table based on time to conduct output control of data from the register to the

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bus, the bridge refers to the time table based on time  
15 to conduct relay processing of data between the buses  
and a reception control unit in the processing element  
refers to the time table based on time to conduct input  
control of data from the bus to the register, thereby  
time-divisionally using the buses.

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13. The interprocessor communication method as set  
forth in claim 8, wherein

a connection table for conducting input/output  
control by a connection number or a data destination and  
5 a time table for conducting input/output control by time  
are provided in the processing element, a connection  
table for conducting relay control by the connection  
number or the data destination is provided in the bridge,  
and a control channel for transmitting the connection  
10 number or the data destination as control information is  
provided in the bus, and

at the time of outputting data from the processor,  
a transmission request is made with the connection  
number or the destination as control information, a  
15 transmission control unit in the processing element  
refers to the connection table and the time table based  
on the control information to conduct output control of  
data and control information to the buses, the bridge  
refers to the connection table based on the control  
20 information received from the control channel to conduct

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25 relay processing of data and control information between  
the buses and a reception control unit in the processing  
element refers to the connection table based on the  
received control information to conduct input control of  
data from the bus to the register, thereby  
time-divisionally using the buses.

14. The interprocessor communication method as set  
forth in claim 1, wherein  
a bus structure formed of a plurality of buses  
and a bridge for relaying data between the buses is used,  
5 in which a group of processing elements is divided into  
a plurality of groups, communication between processing  
elements belonging to the same group is conducted  
through the same one bus and communication between  
processing elements belonging to different groups is  
10 conducted through a plurality of buses using the bridge,  
and

not less than one route which connects the  
processing elements by a bus and causes no contention on  
the same channel of the same bus with other routes is  
15 determined in advance to space-divisionally use the  
buses on a channel basis, thereby conducting only  
interprocessor communication using said determined route.

15. The interprocessor communication method as set  
forth in claim 1, wherein



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5 a bus structure formed of a plurality of local buses, not less than one global bus and a bridge for relaying data between the buses is used, in which a group of processing elements is divided into a plurality of groups, communication between processing elements belonging to the same group is conducted through the same one local bus and communication between processing elements belonging to different groups is conducted through a plurality of buses using the bridge, and

10 not less than one route which connects the processing elements by a bus and causes no contention on the same channel of the same bus with other routes is determined in advance to space-divisionally use the buses on a channel basis, thereby conducting only interprocessor communication using said determined route.

16. The interprocessor communication method as set forth in claim 14, wherein

5 each processor is programmed to execute only the interprocessor communication by said determined route, and each bridge conducts data relay operation only in the interprocessor communication by said determined route, thereby

space-divisionally using the buses.

17. The interprocessor communication method as set forth in claim 14, wherein

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a transmission control unit for controlling  
transmission of the contents of the register file in the  
5 processing element through the bus according to a  
transmission request from the processor belonging to the  
processing element in question provides control such  
that only interprocessor communication by said  
determined route is conducted and each bridge executes  
10 data relay operation only in interprocessor  
communication by said determined route, thereby  
space-divisionally using the buses.

18. The interprocessor communication method as set  
forth in claim 14, wherein

a connection table for conducting input/output  
control is provided for each channel in the processing  
5 element and a connection table for conducting relay  
control is provided for each channel in the bridge, and  
input/output control at the processing element and path  
control at the bridge are determined for each channel by  
using these connection tables, and

10 at the time of outputting data from the processor,  
not less than one register is selected to make a  
transmission request, a transmission control unit in the  
processing element refers to the connection table  
related to a channel corresponding to each register to  
15 which the transmission request is made to conduct output  
control of data from each register to the bus on a

channel basis, the bridge refers to the connection table related to each channel to conduct relay processing of data between the buses for each channel and a reception control unit in the processing element refers to the connection table related to each channel to conduct input control of data from the bus to the register for each channel, thereby space-divisionally using the buses.

19. The interprocessor communication method as set forth in claim 1, wherein a bus structure formed of a plurality of buses and a bridge for relaying data between the buses is used, in which a group of processing elements is divided into a plurality of groups, communication between processing elements belonging to the same group is conducted through the same one bus and communication between processing elements belonging to different groups is conducted through a plurality of buses using the bridge, and

not less than one route which connects the processing elements by a bus and causes no time contention on the same channel of the same bus with other routes and a time of use of a channel of each bus by each route are determined in advance to time-divisionally and space-divisionally use the buses on a channel basis, thereby conducting only interprocessor

communication using said determined route and time of use.

20. The interprocessor communication method as set forth in claim 1, wherein

a bus structure formed of a plurality of local buses, not less than one global bus and a bridge for relaying data between the buses is used, in which a group of processing elements is divided into a plurality of groups, communication between processing elements belonging to the same group is conducted through the same one local bus and communication between processing elements belonging to different groups is conducted through a plurality of buses using the bridge, and

not less than one route which connects the processing elements by a bus and causes no time contention on the same channel of the same bus with other routes and a time of use of a channel of each bus by each route are determined in advance to time-divisionally and space-divisionally use the buses on a channel basis, thereby conducting only interprocessor communication using said determined route and time of use.

21. The interprocessor communication method as set forth in claim 19, wherein

the processors are operated in synchronization

with time and each processor is programmed to execute  
5 only the interprocessor communication by said determined  
route and time of use, and each bridge conducts data  
relay operation only in the interprocessor communication  
by said determined route and time of use, thereby  
time-divisionally and space-divisionally using  
10 the buses.

22. The interprocessor communication method as set  
forth in claim 19, wherein

a transmission control unit for controlling  
transmission of the contents of the register file in the  
5 processing element through the bus according to a  
transmission request from the processor belonging to the  
processing element in question provides control such  
that only interprocessor communication by said  
determined route and time of use is conducted and each  
10 bridge executes data relay operation only in  
interprocessor communication by said determined route  
and time of use, thereby  
time-divisionally and space-divisionally using  
the buses.

23. The interprocessor communication method as set  
forth in claim 19, wherein

a time table for conducting input/output control  
by time is provided for each channel in the processing

5 element and a time table for conducting relay control by  
time is provided for each channel in the bridge, and  
input/output control at the processing element and path  
control at the bridge are determined for each channel  
uniquely with respect to time by using these time tables,  
10 and

when a transmission request is made from the  
processor, a transmission control unit in the processing  
element refers to each time table based on time to  
conduct output control of data from the register to the  
15 bus on a channel basis, the bridge refers to each time  
table based on time to conduct relay processing of data  
between the buses on a channel basis and a reception  
control unit in the processing element refers to each  
time table based on time to conduct input control of  
20 data from the bus to the register on a channel basis,  
thereby

time-divisionally and space-divisionally using  
the buses.

24. The interprocessor communication method as set  
forth in claim 19, wherein

a connection table for conducting input/output  
control by a connection number or a data destination and  
5 a time table for conducting input/output control by time  
are provided in the processing element, a connection  
table for conducting relay control by the connection

number or the data destination is provided in the bridge,  
and a control channel for transmitting the connection  
10 number or the data designation as control information is  
provided for each channel in the bus, and

at the time of outputting data from the processor,  
a transmission request is made with the connection  
number or the destination as control information, a  
15 transmission control unit in the processing element  
refers to each connection table and each time table  
based on control information to conduct output control  
of data and control information to the buses on a  
channel basis, the bridge refers to each connection  
20 table based on the control information received from the  
control channel to conduct relay processing of data and  
control information between the buses on a channel basis  
and a reception control unit in the processing element  
refers to each connection table based on the received  
25 control information to conduct input control of data  
from the bus to the register on a channel basis, thereby  
time-divisionally and space-divisionally using  
the buses.

25. The interprocessor communication method as set  
forth in claim 19, wherein

a connection table for conducting input/output  
control by a connection number or a data destination and  
5 a time table for conducting input/output control by time

are provided in the processing element, a connection table for conducting relay control by the connection number or the data destination is provided in the bridge, and a control channel for transmitting the connection number or the data designation as control information is provided for each channel in the bus, and

at the time of outputting data from the processor, a transmission request is made with the connection number or the destination as control information, a transmission control unit in the processing element refers to the connection table and the time table based on control information to conduct output control of data and control information to the buses on a channel basis, the bridge refers to each connection table based on the control information received from the control channel to conduct relay processing of data and control information between the buses on a channel basis and a reception control unit in the processing element refers to the connection table based on the received control information to conduct input control of data from the bus to the register on a channel basis, thereby time-divisionally and space-divisionally using the buses.

26. The interprocessor communication method as set forth in claim 12, wherein

the transmission control unit in each processing



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each said bus has a channel one-to-one  
corresponding to each register included in the register

5 file.

30. The multiprocessor as set forth in claim 28,  
wherein

each said bus has a channel whose number is  
smaller than the number of the registers included in the  
5 register file.

31. The multiprocessor as set forth in claim 28,  
wherein

each said bus has a channel one-to-one  
corresponding to each register included in the register  
5 file,

the register file of each processing element  
includes a time table for conducting input/output  
control by time, a transmission control unit for, when a  
transmission request is made from the processor,  
10 referring to the time table based on time to control  
output of data from the register to the bus and a  
reception control unit for referring to the time table  
based on time to control input of data from the bus to  
the register, and

15 each bridge includes a time table for conducting  
relay control by time and a relay circuit for referring  
to the time table based on time to conduct relay  
processing of data between the buses, thereby

forming a structure time-divisionally using buses.

32. The multiprocessor as set forth in claim 28,  
wherein

each said bus has a channel whose number is smaller than the number of the registers included in the register file,

the register file of each processing element includes a time table for conducting input/output control by time, a transmission control unit for, when a transmission request is made from the processor, referring to the time table based on time to control output of data from the register to the bus and a reception control unit for referring to the time table based on time to control input of data from the bus to the register, and

each bridge includes a time table for conducting relay control by time and a relay circuit for referring to the time table based on time to conduct relay processing of data between the buses, thereby forming a structure time-divisionally using buses.

33. The multiprocessor as set forth in claim 28,  
wherein

each said bus has a channel one-to-one  
corresponding to each register included in the register  
file,

each bus includes a control channel for

transmitting a connection number or a destination of data as control information,

the register file of each processing element includes a connection table for conducting input/output control by the connection number or the data destination and a time table for conducting input/output control by time, a transmission control unit for, when a transmission request is made from the processor using the connection number or the destination as control information, referring to the connection table and the time table based on the control information to control output of data and control information to the buses, and a reception control unit for referring to the connection table based on control information received from the bus to control input of data from the bus to the register, and

each bridge includes a connection table for conducting relay control by the connection number or the data destination, and a relay control unit and a relay circuit for referring to the connection table based on control information received from the control channel to conduct relay processing of data and control information between the buses, thereby

forming a structure time-divisionally using buses.

34. The multiprocessor as set forth in claim 28, wherein

each said bus has a channel whose number is smaller than the number of the registers included in the register file,

each bus includes a control channel for transmitting a connection number or a destination of data as control information,

the register file of each processing element includes a connection table for conducting input/output control by the connection number or the data destination and a time table for conducting input/output control by time, a transmission control unit for, when a transmission request is made from the processor using the connection number or the destination as control information, referring to the connection table and the time table based on the control information to control output of data and control information to the buses, and a reception control unit for referring to the connection table based on control information received from the bus to control input of data from the bus to the register, and

each bridge includes a connection table for conducting relay control by the connection number or the data destination, and a relay control unit and a relay circuit for referring to the connection table based on control information received from the control channel to conduct relay processing of data and control information between the buses, thereby

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30                   forming a structure time-divisionally using buses.

35.       The multiprocessor as set forth in claim 28,  
wherein

          each said bus has a channel one-to-one  
corresponding to each register included in the register  
5       file, and

          the register file of each processing element  
includes a connection table for each channel for  
conducting input/output control, a transmission control  
unit for, when a transmission request designating a  
10       register which conducts transmission is made from the  
processor, referring to the connection table related to  
a channel corresponding to each register to which the  
transmission request is made to control output of data  
from each register to the bus on a channel basis, and a  
15       reception control unit for referring to the connection  
table related to each channel to control input of data  
from the bus to the register on a channel basis, and

          each bridge includes a connection table for each  
channel for conducting relay control and a relay circuit  
20       for referring to the connection table related to each  
channel to conduct relay processing of data between the  
buses, thereby

          forming a structure space-divisionally using  
buses.

36. The multiprocessor as set forth in claim 28,  
wherein

each said bus has a channel whose number is  
smaller than the number of the registers included in the  
register file, and

the register file of each processing element  
includes a connection table for each channel for  
conducting input/output control, a transmission control  
unit for, when a transmission request designating a  
register which conducts transmission is made from the  
processor, referring to the connection table related to  
a channel corresponding to each register to which the  
transmission request is made to control output of data  
from each register to the bus on a channel basis, and a  
reception control unit for referring to the connection  
table related to each channel to control input of data  
from the bus to the register on a channel basis, and

each bridge includes a connection table for each  
channel for conducting relay control and a relay circuit  
for referring to the connection table related to each  
channel to conduct relay processing of data between the  
buses, thereby

forming a structure space-divisionally using  
buses.

37. The multiprocessor as set forth in claim 28,  
wherein

each said bus has a channel one-to-one  
corresponding to each register included in the register  
5 file,

the register file of each processing element  
includes a time table for each channel for conducting  
input/output control by time, a transmission control  
unit for, when a transmission request is made from the  
10 processor, referring to each time table based on time to  
control output of data from the register to the bus on a  
channel basis, and a reception control unit for  
referring to each time table based on time to control  
input of data from the bus to the register on a channel  
15 basis, and

each bridge includes a time table for each  
channel for conducting relay control by time and a relay  
circuit for referring to each time table based on time  
to conduct relay processing of data between the buses on  
20 a channel basis, thereby

forming a structure time-divisionally and space-  
divisionally using buses.

38. The multiprocessor as set forth in claim 28,  
wherein

each said bus has a channel whose number is  
smaller than the number of the registers included in the  
5 register file,

the register file of each processing element



includes a time table for each channel for conducting  
input/output control by time, a transmission control  
unit for, when a transmission request is made from the  
processor, referring to each time table based on time to  
control output of data from the register to the bus on a  
channel basis and a reception control unit for referring  
to each time table based on time to control input of  
data from the bus to the register on a channel basis,  
and

each bridge includes a time table for each  
channel for conducting relay control by time and a relay  
circuit for referring to each time table based on time  
to conduct relay processing of data between the buses on  
a channel basis, thereby

forming a structure time-divisionally and space-  
divisionally using buses.

39. The multiprocessor as set forth in claim 28,  
wherein

each said bus has a channel one-to-one  
corresponding to each register included in the register  
file,

each bus includes a control channel for each  
channel for transmitting a connection number or a  
destination of data as control information,

the register file of each processing element  
includes a connection table for each channel for

conducting input/output control by the connection number  
or the destination of data and a time table for each  
channel for conducting input/output control by time, a  
transmission control unit for, when a transmission  
15 request with the connection number or the destination as  
control information is made from the processor,  
referring to each connection table and each time table  
based on the control information to control output of  
the data and the control information to the bus on a  
20 channel basis, and a reception control unit for  
referring to each connection table based on control  
information received from the bus to control input of  
data from the bus to the register on a channel basis,  
and

25 each bridge includes a connection table for each  
channel for conducting relay control by the connection  
number or the data destination, and a relay control unit  
and a relay circuit for referring to each connection  
table based on control information received from the  
30 control channel to conduct relay processing of data and  
the control information between the buses on a channel  
basis, thereby

forming a structure time-divisionally and space-  
divisionally using buses.

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40. The multiprocessor as set forth in claim 28,  
wherein

each said bus has a channel whose number is smaller than the number of the registers included in the register file,

each bus includes a control channel for each channel for transmitting a connection number or a destination of data as control information,

the register file of each processing element includes a connection table for each channel for conducting input/output control by the connection number or the destination of data and a time table for each channel for conducting input/output control by time, a transmission control unit, for when a transmission request with the connection number or the destination as control information is made from the processor, referring to each connection table and each time table based on the control information to control output of the data and the control information to the bus on a channel basis, and a reception control unit for referring to each connection table based on control information received from the bus to control input of data from the bus to the register on a channel basis, and

each bridge includes a connection table for each channel for conducting relay control by the connection number or the data destination, and a relay control unit and a relay circuit for referring to each connection table based on control information received from the

30 control channel to conduct relay processing of data and  
the control information between the buses on a channel  
basis, thereby

forming a structure time-divisionally and space-  
divisionally using buses.

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41. The multiprocessor as set forth in claim 28,  
wherein

each said bus has a channel one-to-one  
corresponding to each register included in the register  
5 file,

each bus includes a control channel for each  
channel for transmitting a connection number or a  
destination of data as control information,

the register file of each processing element  
10 includes a connection table for conducting input/output  
control by the connection number or the data destination  
and a time table for conducting input/output control by  
time, a transmission control unit for, when a  
transmission request is made from the processor using  
15 the connection number or the destination as control  
information, referring to the connection table and the  
time table based on the control information to control  
output of data and control information to the buses on a  
channel basis, and a reception control unit for  
20 referring to the connection table based on control  
information received from the bus to control input of

data from the bus to the register on a channel basis,  
and

each bridge includes a connection table for each  
25 channel for conducting relay control by the connection  
number or the data destination, and a relay control unit  
and a relay circuit for referring to each connection  
table based on control information received from the  
control channel to conduct relay processing of the data  
30 and the control information between the buses on a  
channel basis, thereby

forming a structure time-divisionally and space-  
divisionally using buses.

42. The multiprocessor as set forth in claim 28,  
wherein

each said bus has a channel whose number is  
smaller than the number of the registers included in the  
5 register file,

each bus includes a control channel for each  
channel for transmitting a connection number or a  
destination of data as control information,

the register file of each processing element  
10 includes a connection table for conducting input/output  
control by the connection number or the data destination  
and a time table for conducting input/output control by  
time, a transmission control unit for, when a  
transmission request is made from the processor using

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15 the connection number or the destination as control  
information, referring to the connection table and the  
time table based on the control information to control  
output of data and control information to the buses on a  
channel basis, and a reception control unit for  
20 referring to the connection table based on control  
information received from the bus to control input of  
data from the bus to the register on a channel basis,  
and

25 each bridge includes a connection table for each  
channel for conducting relay control by the connection  
number or the data destination, and a relay control unit  
and a relay circuit for referring to each connection  
table based on control information received from the  
control channel to conduct relay processing of the data  
30 and the control information between the buses on a  
channel basis, thereby

forming a structure time-divisionally and space-  
divisionally using buses.

43. The multiprocessor as set forth in claim 31,  
wherein

5 the transmission control unit in each processing  
element has a structure of inhibiting, after a  
transmission request is made, write from a processor  
into a register relevant to the transmission request  
until data is actually output onto the bus.

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a structure of inhibiting read of the contents of a register file scheduled to be received and changing the contents to be readable at a time when the reception control unit inputs the data received through the bus into the register file in the processing element.